LABORATORY FUME HOODS

RECOMMENDED PRACTICES

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SEFA™

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FURNITURE ASSOCIATION

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FOREWORD

SEFA Profile

The Scientific Equipment and Furniture Association (SEFA) is a voluntary national trade association representing members of the laboratory furniture, casework, fume hood and related equipment industry. The Association was founded to promote this rapidly expanding industry and to improve the quality, safety and timely completion of laboratory facilities in accordance with customer requirements.

SEFA Glossary of Terms

SEFA has developed a glossary of terms for the purpose of promoting a greater understanding between designers, architects, manufacturers, purchasers and end users. The terms defined by SEFA are frequently used in contracts and other documents which attempt to define the products to be furnished or the work involved. The association has approved this glossary in an effort to provide uniformity among those who use these terms.

SEFA encourages all interested parties to submit additional terms or to suggest any changes to those terms already defined by the association. The glossary should be used to help resolve any disputes that may rise or to incorporate the applicable terms in any contract or related documents.

SEFA Recommended Practices

SEFA and its committees are active in the development and promotion of recommended practices having domestic and international applications. Recommended practices are developed by the association taking into account the work of other national standard-writing organizations. Liaison is also maintained with governmental agencies in the development of their specifications.

SEFA's recommended practices are developed in and for the public interest. These Practices are designed to promote better understanding between manufacturers and purchasers and to assist the purchaser in selecting and specifying the proper product to meet the user's particular needs. The existance of a SEFA recommended practice does not preclude any member or non-member from providing products or services that do not conform to these recommended practices. SEFA welcomes any proposed changes or additions to these recommended practices and encourages all interested parties to participate in this important endeaver.

SEFA's recommended practices and the glossary of terms are not copyrighted and may be disseminated for their widest possible use by quoting or photocopying whenever necessary.

1. SCOPE

1.1 This Recommended Practice is limited to the design, materials of construction, use and testing of laboratory fume hoods. It is not intended to cover related laboratory devices, such as laminar flow cabinets, glove boxes or canopy hoods.

1.2 This Recommended Practice is not intended to cover other elements of a fume removal system, such as blowers or ducts. Information on these items, as they relate to laboratory fume hood operation, is found in the Appendices.

1.3 In this Recommended Practice, a laboratory fume hood is defined as a ventilated, enclosed work space intended to capture, contain and exhaust fumes, vapors and particulate matter generated inside the enclosure. It consists basically of side, back and top enclosure panels, a floor or counter top, an access opening called the face, sash(es) and an exhaust plenum equipped with a baffle system for airflow distribution. The supporting unit(s) is (are) not covered in this Recommended Practice.

SEFA Disclaimer.SEFA uses its best effort to promolgate Recommended Practices for the benefit of the public in light of available information and accepted industry practices. SEFA does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with SEFA Recommended Practices or that any tests conducted under its Recommended Practice will be nonhazardous or free from risk.

2. PURPOSE

The purpose of this Recommended Practice is to provide a working knowledge of laboratory fume hoods, including the design, construction, installation, operation and testing recommendations.

SEFA recognizes the importance of good laboratory practice and laboratory safety. SEFA acknowledges other national and international standard writing organizations and government agencies that produce documents concerning laboratory fume hoods such as:

ASHRAE–American Society of Heating, Refrigerating & Air Conditioning Engineers

ANSI–American National Standards Institute

ASTM–American Society Testing Material

ACS–American Chemical Society, Chemical Health & Safety Division

NFPA–National Fire Protection Association

BSA–British Standard Agency

EPA–Environmental Protection Agency

OSHA–Occupational Safety & Health Agency

NIOSH–National Institute Occupational Safety & Health Agency

NIH–National Insitute of Health

ADA–American Disability Act

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3. DEFINITIONS

access opening–That part of the fume hood through which work is performed; sash or face opening.

air flow monitor–An alarm device installed in a fume hood to monitor the air flow through the fume chamber of a fume hood.

air foil–A horizontal member across the lower part of the fume hood sash opening. Shaped to provide a smooth air flow into the fume chamber across the worksurface.

air volume–Quantity of air expressed in cubic feet (ft^3) or cubic meters (m^3).

ANSI/ASHRAE 110-1995–A fume hood performance test developed and promulgated by the American Society of Heating, Refrigerating, and Air Conditioning Engineers and The American National Standards Institute.

auxiliary air–Supply or supplemental air delivered to a laboratory fume hood to reduce room air consumption.

baffle–Panel located across the rear wall of the fume hood chamber interior, and directs the air flow through the fume chamber.

bench hood–A fume hood that is located on a work surface. (See superstructure)

biological cabinet–Enclosure used to handle pathogenic microorganisms; this device is not a laboratory fume hood.

blower–Air moving device, sometimes called a fan, consisting of a motor, impeller and housing.

BS 7258–A fume hood containment test developed by the British Standards Association, used in most commonwealth countries.

bypass–Compensating opening in a fume hood that functions to limit the maximum face velocity as the sash is raised or lowered.

California type hood–A rectangular enclosure used to house distillation apparatus that can provide visibility from all sides with horizontal sliding access doors along the length of the assembly.

canopy hood–Ventilating enclosure suspended above work area to exhaust heat, vapor or odors. This device is not a laboratory fume hood.

capture velocity–Speed of air flowing past the face opening through fume chamber at a speed necessary to capture generated fume vapors and/or particulate and directed to the exhaust outlet. Measured in feet per minute (fpm) or meter per second (mps).

combination hood–A fume hood assembly containing a bench hood section and a walk-in section.

combination sash–A fume hood sash with a framed member that moves vertically housing two or more horizontal sliding transparent viewing panels.

counter top–Work surface resting on a base cabinet, nominally three feet (91.4 cm) (0.914 m) high.

cross drafts–Air draft that flows parallel to or across the face opening of the fume hood.

damper–Device installed in a duct to control air flow volume.

demonstration hood–A vented enclosure used for student demonstrations that has visibility on at least two sides. Used primarily in schools. This device is not a laboratory fume hood.

distillation hood–A laboratory fume hood that provides a work surface approximately 18 inches (45.7 cm) (0.457 m) above the room floor, to accommodate tall apparatus.

dual entry hood–A bench type fume hood that has two sash opeingings, usually on opposite side.

duct–Round, square or rectangular tube used to enclose moving air.

duct velocity–Speed of air moving in a duct, usually expressed in feet per minute (fpm) or meters per second (mps).

exhaust collar–Connection between duct and fume hood through which all exhaust air passes.

face–Front access or sash opening of laboratory fume hood. Face opening measured in width and height. See sash or access opening.

face velocity–Average speed of air flowing perpendicular to the face opening and into the fume chamber of the fume hood and expressed in feet per minute (fpm), measured at the plane of the face or sash opening.

fan–Air moving device, usually called a blower, consisting of a motor, impeller and housing.

filter–Device to remove particles from air.

fume chamber–The interior of the fume hood measured in width, depth and height constructed of material suitable for intended use.

fume removal system–A fume hood exhaust engineered to effectively move air and fumes consistently through fume hood, duct and exhaust blower.

Note: Room air, make-up air, auxiliary air (if used) and pollution-abating devices (if used) are integral parts of a properly functioning system and should be considered when designing a fume removal system.

glove box–Total enclosure used to confine and contain hazardous materials with operator access by means of gloved portals or other limited openings; this device is not a laboratory fume hood.

imbalance–Condition in which the ratio of quantities of supply air is greater or lesser than the exhaust air.

laminar flow cabinet–Name applied to clean bench or biological enclosures. This device is not a laboratory fume hood.

liner–Interior lining used for side, back and top enclosure panels, exhaust plenum and baffle system of a laboratory fume hood.

make-up air–Air needed to replace the air taken from the room by laboratory fume hood(s) and other air exhausting devices.

manometer–Device used to measure air pressure differential, usually calibrated in inches of water.

negative air pressure–Air pressure lower than ambient.

particulate matter–For this Recommended Practice, small, light-weight particles that will be airborne in low-velocity air [approximately 50 fpm (.25 m/s)].

pitot tube–Device used to measure air pressure differential, usually calibrated in inches of water.

plenum chamber–Chamber used to equalize air flow.

positive air pressure–Air pressure higher than ambient.

room air–That portion of the exhaust air taken from the room.

sash–Movable panel at the access opening.

scrubber, fume–A device used to remove contaminants from fume hood exhaust, normally utilizing water.

service fixture–Item of laboratory plumbing mounted on or fastened to laboratory fume hood.

slot velocity–Speed of air moving through fume hood baffle openings.

smoke candle–Smoke-producing device used to allow visual observation of air flow.

spot collector–A small, localized ventilation hood usually connected by a flexible duct to an exhaust fan. This device is not a laboratory fume hood.

static pressure–Air pressure in laboratory fume hood or duct, usually expressed in inches of water.

static pressure loss–Measurement of resistance created when air moves through a duct or hood, usually expressed in inches of water.

superstructure–That portion of a laboratory fume hood that is supported by the work surface.

supplemental air–Supply or auxiliary air delivered to a laboratory fume hood to reduce room air consumption.

table top hood–A small, spot ventilation hood for mounting on table tops. Used primarily in educational laboratories. This device is not a laboratory fume hood.

thermal anemometer–A device for measuring fume hood face velocity utilizing the principle of thermal cooling of a heated element as the detection element.

threshold limit value-time weighted average (TLV-TWA)–The time-weighted average concentration for a normal 8-hour workday or 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

titanium tetrachloride–Chemical that generates white fumes used in testing laboratory fume hoods.

total pressure–Algebraic sum of velocity pressure and static pressure.

transport velocity–Minimum speed of air required to support and carry particles in an air stream.

velocity pressure–Pressure caused by moving air in a laboratory fume hood or duct, usually expressed in inches of water.

walk-in hood–A floor-mounted, full-height fume hood, designed to accommodate tall apparatus and permit roll-in of instruments and equipment.

weather cap–Device used at the top of an exhaust stack to prevent rain from entering the stack end.

work space–That part of the fume hood interior where apparatus is set up and fumes are generated. It is normally confined to a space extending from six inches (15.2 cm) (152 mm) behind the plane of the sash(es) to the face of the baffle, and extending from the work surface to a plane parallel with the top edge of the access opening.

work surface–The surface that a laboratory fume hood is located on and supported by a base cabinet. In the fume chamber the surface is recessed to contain spills.

4. DESIGN REQUIREMENTS

4.1 Laboratory Fume Hood

4.1.0 Static Pressure Loss Fume Hood. The fume hood manufacturer shall state the design static pressure loss of each model fume hood in inches (mm) of water at specific face velocity. The fume hood static pressure loss is useful in sizing the exhaust system.

4.1.1 Interior. Fume chamber and baffles shall be constructed of materials that are resistant to the chemical fumes, vapors and condensation particulate that may collect and deposit on the interiour surface of the fume chamber and baffles.

Consideration should be given to the specifications of liner materials that are resistant to the chemical exposure in the fume chamber. Typical liner materials are stainless steel type 304 and 316, thermoplastics P.V.C. and HDPP and thermoset composite. Also chemical resistant mineral board and sheetsteel. the fume hood liner material should be suitable for the use intended.

When flammables are used or if there is a potential for a fire within the fume chamber of the fume hood, the liner material shall be fire retardant, self-extinguishing and have a flame spread rating of 25 or less in accordance with ASTM-E84 test procedures. If there is a potential fire hazard in the fume chamber, for safety reasons the fume hood should be equipped with automatic fire suppression and alarm system.

4.1.2 Exterior. Exterior panels and internal framework shall be resistant to chemical fumes and chemical exposure encountered in the laboratory.

4.1.3 Baffle. The baffle design shall be such to provide uniform air movement through the fume chamber. Constructed of material same as, or similar to, fume hood interior. Baffles shall be removable to allow periodic inspection and cleaning.

4.1.4 Lighting.

4.1.4.1 Light fixture(s) mounted exterior to the fume chamber shall be protected from the interior by a sealed vapor tight transparent, impact resistant lens. Access for relamping or cleaning chould be from the exterior.

4.1.4.2 Light fixture(s) mounted inside the hood liner shall be protected against corrosion and shall be vapor proof or explosion proof according to the appropriate specification.

4.1.5 Work Surface. The work surface shall be designed to contain spills. (See SEFA 3)

4.1.6 Service Fixtures. All service fixtures shall be installed so that service supply lines can be connected or disconnected, either by design of the piping assembly or through an access panel in the hood interior or exterior. All service valves shall be accessible for maintenance. All service fixture controls (e.g., gas, air, water, vacuum) should be external to the hood interior, clearly identified and within easy reach. All internal service fixture outlets shall be corrosion resistant or have a corrosion-resistant finish. If water service is provided, the hood shall have a drain of suitable design unless the drain is specifically omitted as a design requirement. (See SEFA Recommended Practices for Laboratory and Hospital Service Fixtures, SEFA 7.)

4.1.7 Electrical Receptacles. All electrical receptacles should be readily accessible and external to fume hood interior. Provisions shall be made so that all electrical wiring will be isolated and physically separated from vapors handled within the hood interior after the fume hood is installed.

4.1.8 Sash. A transparent, easily-movable, horizontal sliding or vertical rising panel that will substantially close off the hood face shall be provided. A vertical rising sash shall be counterbalanced. A sash shall move easily and quietly, yet remain in place wherever stopped. Components of sash guides, internal sash surfaces and counterbalance mechanism, when used, which are exposed to corrosive fumes, shall be of corrosion-resistant material or finish. All sashes shall be safety glass or plastic which has a flammability rating of 25 or less when tested in accordance with ASTM E-84. When high internal temperatures are anticipated that will result in sash surface temperatures in excess of 160 degrees F (71.1 degrees C), tempered safety glass or other suitable material should be specified.

4.1.9 Static Pressure Loss, Bench Mounted Fume Hood. With sash at full-open position, static pressure loss through the fume hood shall be no more than 1/4 inch (0.635 cm) (6.35 mm) of water gauge when the fume hood operates at face velocity of 75 feet per minute (22.9 m/min) (.38 m/s), 7/8 inch (0.943 cm) (9.43 mm) of water gauge at 100 feet per minute (30.48 m/min) (.51 m/s), 1/2 inch (1.27 cm) (12.7.9 mm) of water gauge at 125 feet per minute (38.1 m/min) (.64 m/s). The manufacturer shall state the design static pressure loss for all standard catalog models. For all laboratory fume hoods equipped with a bypass, static pressure loss and exhaust volume shall be relatively constant regardless of sash position.

Other types of fume hoods, as specified by manufacture.

4.1.10 Air Flow Monitor. Monitors the airflow through the fume chamber as a predetermined range. The monitor shall provide a audible and visible warning when the air flow falls outside the predetermined range. For safety reasons all fume hoods should be equipped with air flow monitors.

4.2 Laboratory Fume Hoods With Special Design Features. Laboratory fume hoods with special design features shall conform to the design requirements covered in section 4.1 of this Recommended Practice, as well as any applicable additional requirements. A special requirement takes precedence over a normal requirement.

4.2.1 Bypass-Type Hoods. Bypass-type fume hoods shall incorporate an automatic compensating opening which functions as the sash(es) is (are) closed. Air drawn through the bypass shall pass through the hood interior to dilute and exhaust generated fumes. The bypass shall limit face velocity increases and maintain a relatively constant exhaust volume.

4.2.1.1 Restricted Bypass Hoods. Fume hood with a restricted bypass area to limit bypass leakage on hoods with horizontal, combination or postless sash designs. Restricted bypass hoods should also be used whenever the hood is connected to a VAV system.

4.2.2 Laboratory Fume Hoods for Use with Perchloric Acid.

4.2.2.1 Laboratory fume hoods for use with perchloric acid shall be identified by a label indicating suitability for use with perchloric acid procedures.

4.2.2.2 The perchloric acid fume hood interior shall be constructed of materals suitable for use with perchloric acid. The fume chamber shall be water tight and easilty cleaned.

4.2.2.3 The work surface shall be an integral with the fume chamber, water tight and recessed to contain spillage and wash down waste waters.

4.2.2.4 The fume hood shall be equipped with a water spray wash down system to clean surfaces of the fume chamber and area behind the baffle.

4.2.2.5 Service fitting controls for internal outlets and for the washdown system shall be external to the hood, clearly identified and within easy reach.

4.2.2.6 The baffle shall be removable to allow periodic inspection or cleaning.

4.2.3 Laboratory Fume Hoods for Use With Radioactive Materials (Commonly Called Isotope Hoods).

4.2.3.1 Fume hoods shall be properly labeled prior to use with radioactive materials and used strictly for isotope work.

4.2.3.2 Isotope hoods shall have integral fume chamber and work surface with all radiuses corners constructed of non porous or sealed materials that preclude absorption of radioactive materials and shall resist the corrosive action of chemicals used in isotope work.

4.2.3.3 The work surface shall be watertight and dished to contain spills and cleaning liquids and shall be properly reinforced to support lead shielding and shielded containers. The load-bearing capacity shall be 200 pounds per square foot (97.65 Kg/m^2) minimum up to a total weight of 1000 pounds (453.6 Kg) per fume hood or base cabinet section.

4.2.3.4 Isotope fume hoods with filters in the exhaust duct should always have independent duct and blower system.

4.2.4 Walk-In and Distillation Hoods.

4.2.4.1 Fume hood work surface or floor shall be designed to contain spills.

4.2.4.2 The static pressure loss shall be specified by the manufacturer.

4.2.4.3 The hood shall be provided with two or more sashes to facilitate access to the working area.

4.2.4.4 The hood shall have adjustable baffles to control the pattern of air moving through the fume hood.

4.2.5 Combination Hoods.

4.2.5.1 Combination fume hoods shall conform to the requirements of bench-mounted hoods as set forth in section 4.1 and to the requirements of walk-in hoods as set forth in section 4.2.4, as applicable.

4.2.6 Fume Hoods Utilizing an Auxiliary Air System.

4.2.6.1 The auxiliary air system shall function to reduce the consumption of conditioned room air.

4.2.6.2 The auxiliary air shall be introduced exterior to the fume hood face with the sash(es) open.

4.2.6.3 Auxiliary air shall enter the fume hood through the face with the sash(es) open.

4.2.6.4 Auxiliary air shall be distributed across the face area prior to its passage into the hood with the sash(es) open.

4.2.6.5 With the sash(es) closed, auxiliary air shall be introduced into the fume hood interior in such a manner as to aid in the dilution of heat and fumes generated in the work area.

4.2.6.6 Auxiliary air capture efficiency shall meet manufacturer's specifications.

Note: Consideration should be given to preconditioning and filtering auxiliary air.

4.2.6.7 Auxiliary air fume hoods shall also conform to the following requirements:

(1) Provide safe capture and efficient removal of fumes from the hood when operated at air ratios specified by the manufacturer.

(b) Capture the percentage of auxiliary air as specified by the manufacturer when operated with the sash(es) open or closed.

(c) Capture, contain and carry away fumes generated in the work area when operated at a condition of imbalance between the auxiliary air and room air as specified by the manufacturers.

(d) Function in accordance with the performance characteristics listed above when tested by appropriate evaluation procedures.

4.2.6.8 The manufacturer shall include auxiliary air static pressure data for all standard catalog models.

5. FACE VELOCITY

5.1 Special Considerations. The establishment of the proper face velocity for a specific laboratory fume hood should be based on a number of factors, including the following:

5.1.1 Room Conditions That Prevail in the Area Where the Fume Hood Is To Be Installed. Cross drafts, created by the room ventilation system or from an open window or corridor, if located adjacent to the hood, can drastically disturb the flow of air entering the fume hood face and even cause a reverse flow of air out of the front of the fume hood. Room conditions such as these should be avoided, if at all possible, by the location of the fume hood or modifying the hood exhaust system so an appropriate increase in face velocity can be made to overcome their effect. In no case should the velocity of the cross drafts exceed 20 percent of the fume hood face velocity.

5.1.2 Toxicity Level of the Materials To Be Used in the Fume Hood. Materials of little or no toxicity require face velocities only sufficient to maintain control under normal operating conditions. As toxicity levels increase, face velocity should be increased to assure control under a greater variety of conditions of use. Typical conditions of use that require higher than minimum face velocity include:

(a) High heat loads which create thermal drafts that increase face velocity through the bottom of the fume hood opening and thus lower face velocities at the top of the fume hood opening.

(b) Generation velocity, direction and volume of fumes must be taken into consideration.

(c) Special or bulky equipment that interferes with air flow through the fume hood.

5.1.3 Specific Materials That Are to Be Used in the Fume Hoods Which May Affect Face Velocity. Light weight powders that have no toxicity hazard may dictate very low face velocities. Kymograph hoods also require very low velocities. Hoods used to house laboratory type machine tools, grinders or centrifuges may require higher face velocities than toxicity levels might dictate.

5.2 Face Velocity Guide. Face velocities of laboratory fume hoods may be established on the basis of the toxicity or hazard of the materials used or the operations conducted within the fume hood.

Note: Governmental codes, rules and regulations may require specific face velocities. A fume hood face velocity of 100 fpm is considered acceptable in standard practice. In certain situations face velocity of up to 125 fpm or as low as 75 fpm may be acceptable to meet required capture velocity of the fume hood.

6. LABORATORY FUME HOOD PERFORMANCE EVALUATION IN A TEST FACILITY (A Quantitative Test) ASHRAE 110-1993

6.1 Test Model. The fume hood to be tested shall be a manufacturer's standard catalog model, with sash(es). The fume hood shall be installed on the manufacturer's standard base unit(s) in accordance with the manufacturer's fume hood installation instructions.

6.2 Testing. If required, SEFA recommends that the test model be evaluated in accordance to ANSI/ASHRAE 110-1995 test procedure. Copies of this test procedure may be obtained from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329.

6.3 Compliance to Design Requirements. A physical examination shall be made to verify that the test model is in compliance with applicable parts of Section 4.

6.4 Face Velocity Measurement

6.4.1 Equipment List.

(a) A properly calibrated hot-wire thermal anemometer.

(b) Bottles titanium tetrachloride and supply of cotton swabs or other smoke producing device.

(c) Two dozen 1/2 minute smoke candles.

6.4.2 Test Procedure. The following tests should be performed in the order listed:

6.4.2.1 Room Conditions. After the fume hood is installed, and with make-up air being introduced into the room, check room condition in front of the fume hood using a thermal anemometer and a cotton swab dipped in titanium tetrachloride to verify that the velocity of cross drafts does not exceed 20 feet per minute (6.1 m/min) (.10 m/s), or 20 percent of the average fume hood velocity, whichever is greater. Any cross drafts that exceed these values shall be eliminated before proceeding with hood test.

Caution: Titanium tetrachloride fumes are toxic and corrosive; use sparingly, avoid inhalation and exposure to body, clothing and equipment that might be affected by corrosive fumes. A smoke generator device is recommended.

6.4.2.2 Face Velocity. With the sash(es) in the appropriate position (as indicated below), turn on the exhaust blower and adjust to the proper face velocity (See Section 5.2.)

The face velocity shall be determined by averaging readings taken at the fume hood face. Readings shall be taken at the center of a grid made up of sections of equal area, as shown in the diagrams. (See Figures 1 through 5 on page 20 for grid design). Readings shall conform to criteria stated in Section 5.2.

6.4.2.2.1 Bench-mounted hoods with vertical rising sash(es) shall be rated and tested with all sashes in fully opened or in position defined by specifier.

6.4.2.2.2 Walk-in or distillation hoods with vertical rising sash(es) shall be rated and tested with one sash in the fully opened or in position defined by specifier.

6.4.2.2.3 Fume Hoods with horizontal sliding sash(es) shall be rated and tested with alternate at left, center, and right positions.

6.4.2.3 Baffle Restriction. Measure exhaust air volume with baffles positioned to give maximum air flow. Adjust baffles and verify that air volume at minimum airflow is not less than 95 percent of the exhaust air volume at maximum air flow. After test, return baffles to original position.

6.4.2.4 Static Pressure Loss. On a plane perpendicular to the center line of the duct, drill four holes in the duct. The diameter of the holes should be between 1/16 and 1/8 inch (.16 cm and .32 cm) (1.6 mm and 3.2 mm). The holes should be spaced 90 degrees a part around the duct and be located between one and three duct diameters from the connection to the hood. Using a soft rubber tip for effective seal, connect the manometer to each hole in turn. Record the reading under stated air flow conditions, and calculate the average. The static pressure loss shall not exceed values given in Section 4.1.9. Seal holes with duct tape or suitable sealant.

Note: The holes must be smooth on the interior surface to avoid projections which will distort readings.

6.4.2.5 Verification of Proper Air Flow and Patterns.

6.4.2.5.1 Fume Hoods With Vertical Rising Sash(es) Without Auxiliary Air. With sash(es) in full open position, conduct the following tests:

(a) Using a smoke generating device, make a complete traverse of the fume hood face to determine that a positive flow of air is being maintained over the entire fume hood face. No reverse flow of air shall be evident.

(b) Paint a strip of titanium tetrachloride along each end and across the working surface of the fume hood, in a line parallel to the fume hood face and six inches (15.2 cm) (152 mm) back into the fume hood. Note the air flow. No reverse flow of air shall be evident in the work area.

(c) Ignite a smoke candle within the fume hood work area to verify that the fumes are quickly and efficiently carried away. The lighted candle shall be moved about the fume hood work area, checking near fume hood ends and work surface to verify that there is no reverse flow of air at these locations.

6.4.2.5.2 Fume Hoods With Horizontal Sliding Sash(es) Without Auxiliary Air.

(a) Adjust sashes to various full open positions and verify with cotton swab dipped in titanium tetrachloride that a positive flow of air is passing through the entire open fume hood face. No reverse flow of air shall be evident.

(b) Paint a strip of titanium tetrachloride along each end and along the working surface of the fume hood, in a line parallel to the fume hood face and six inches (15.2 cm) (152 mm) back into the fume hood. Move sash(es) to various positions and note air flow in the hood. Forward flow and turbulence will occur behind the sash panels but no outflow of smoke shall be evident.

(c) Ignite a smoke candle within the work area and, with sash(es) in various full open positions, verify that no smoke escapes through the open face area.

6.4.2.5.3 Fume Hoods With Vertical Rising Sash(es) and Auxiliary Air.

Note: Face velocity and exhaust volumes shall be determined with the auxiliary air blower off.

(a) When the selected face velocity has been obtained, the volume of exhaust air should be verified by multiplying the average face velocity by the square foot area of the fume hood face opening. The volume of exhaust air may be determined by other recognized procedures. The auxiliary air blower shall now be turned on and adjusted to give the proper quantity of auxiliary air to provide a ratio of room air to auxiliary air as specified or recommended by the fume hood manufacturer. The quantity of auxiliary air should be determined by the use of a calibrated orifice in the auxiliary air duct to determine the average duct velocity multiplied by the cross sectional area of the duct. The quantity of auxiliary air may be determined by other recognized procedures. The temperature of the auxiliary air shall be adjusted to 15 degrees F (8.3 degrees C) above the room air temperature.

(b) When the proper air volumes and temperatures have been obtained, and with sash(es) in the full open position, except as indicated, conduct the following tests:

(1) Using a cotton swab dipped in titanium tetrachloride, make a complete traverse of the fume hood face to determine that a positive flow of air is being maintained over the entire fume hood face. No reverse flow of air shall be evident.

(2) Paint a strip of titanium tetrachloride along each end and across the working surface of the fume hood, in a line parallel to the fume hood face, and six inches (15.2 cm) (152 mm) back into the fume hood. Note air flow. No reverse flow of air shall be evident in the work area. Smoke shall be contained and exhausted.

(3) Ignite a smoke candle within the fume hood work area to verify that the fumes are quickly and efficiently carried away. The lighted bomb shall be moved about the fume hood work area, and the area near fume hood ends and work surface should be checked to verify that there is no reverse flow of air at these locations.

(4) Discharge a smoke candle into the auxiliary air duct ahead of the blower, to insure that the smoke is thoroughly mixed with the auxiliary air. Observe the flow of smoke and air, down and into the fume hood face, to verify that capture efficiency is within the manufacturer's specifications.

(c) With the sash(es) in the closed position, discharge a smoke candle in the auxiliary air duct and verify that all the smoke and air is captured and is drawn through the fume hood work area.

6.4.2.6 Evaluation of Options.

6.4.2.6.1 Variable Air Volume Control Systems. (to be installed, calibrated & evaluated in accordance to manufacturers recommendations.) By design, variable air volume (VAV) systems correct for alarm conditions. When evaluation & testing, temporary alarm conditions may exist when the controls are responding to changes in face velocity. Caution must therefore be exercised if using smoke candles or titanium tetrachloride during testing procedures.

6.4.2.6.2 Low Air Flow Monitor. Slowly reduce exhaust air volume until low flow signal is given. Measure face velocity and calculate average face velocity. Verify that function meets specification requirements.

7. FUME HOOD EVALUATION IN THE FIELD

(A Qualitative Test) formerly SAMA Standard LF10-1980

It is recommended that the user make provisions to have the following tests performed on all laboratory fume hoods. These tests should be performed by qualified personnel to verify proper operation of the fume hoods before they are put to use. The tests of the fume hoods should be performed after the installation is complete, the building ventilation system has been balanced and all connections made. Any unsafe conditions disclosed by these tests should be corrected before using the hood.

7.1 Test Conditions. Verify that building make-up air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at design conditions.

7.2 Test Procedures.

7.2.1 Equipment List.

(a) A properly calibrated hot-wire thermal anemometer.

(b) A supply of 1/2 -minute smoke candles.

(c) A bottle of titanium tetrachloride and supply of cotton swabs or other recognized device for producing smoke.

7.2.2 Room Conditions. Check room conditions in front of the fume hood using a thermal anemometer and a smoke source to verify that the velocity of cross drafts does not exceed 20 percent of the specified average fume hood face velocity. Any cross drafts that exceed these values shall be eliminated before proceeding with fume hood test.

Caution: Titanium Tetrachloride fumes are toxic and corrosive, use sparingly, avoid inhalation and exposure to body, clothing and equipment that might be affected by corrosive fumes. Note: It must be recognized that no fume hood can operate properly if excessive cross drafts are present.

7.2.3 Face Velocity. Determine specified average face velocity for fume hood being tested. Perform the following test to determine if fume hood velocities conform to specifications or to the designated fume hood class in accordance with section 5.2. With the sash(es) positioned in accordance with 6.4.2.2, turn on the exhaust blower. The face velocity shall be determined by averaging the velocity readings taken at the open fume hood face. Readings shall be taken in accordance with figures 1 through 5 on page 20.

Note: If not in accordance with specified face velocity, refer to Appendix A (Troubleshooting Guide) for aid in determining the cause of variation in air flow. If face velocity cannot be corrected to that specified, reclassify fume hood to conform to actual face velocity.

7.2.4 Sash Operation. Check operation by moving sash(es) through its (their) full travel. Sash operation shall be smooth and easy. Vertical rising sashes shall hold at any height without creeping up or down, unless designed otherwise.

7.2.5 Verification of Proper Air Flow and Patterns.

7.2.5.1 Fume Hoods Without Auxiliary Air.

(a) Turn fume hood exhaust blower on.

(b) With sash(es) in full open position, check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source.

Note: On fume hoods with horizontal sliding sash(es), check air flow with sash(es) at various full open positions. A complete traverse of the fume hood face should verify that air flow is into the fume hood over the entire face area. A reverse flow of smoke indicates unsafe fume hood operation. Consult Appendix A or B for possible causes and take corrective action.

(c) Move a lighted smoke candle throughout the fume hood work area, directing smoke across the work surface and against the side walls and baffle. Smoke should be contained within the fume hood and be rapidly exhausted. (Fume hoods with horizontal sliding sash(es) will show reverse flow and turbulence behind sash panel, but no outflow of smoke shall be evident.)

7.2.5.2 Fume Hoods With Auxiliary Air.

(a) Turn exhaust blower on and determine face velocity in accordance with 7.2.3.

Note: Face velocity and exhaust volumes shall be determined with the auxiliary air blower off.

(b) Calculate exhaust volume from face velocity data.

(c) Turn on auxiliary air, verify that auxiliary air volume is as specified. Locate a straight section of the supply air duct and drill two holes of a size appropriate for the pitot tubes to be used, 90 degrees apart, on a plane through the duct, at the downstream end of the straight section. Measure the air velocity and calculate the air volume. Compare volumes determined with the specified volume of auxiliary air and with exhaust volume, to determine if proper ratio exists. Deviations of plus or minus five percent are acceptable. If deviations of more than five percent are noted, corrective measures should be taken. Seal holes in duct with duct tape or suitable sealant.

(d) With sash(es) in the open position, check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source. A complete traverse of the fume hood face should verify that air flow is into the fume hood over the entire face area. A reverse flow of air indicates unsafe fume hood operation. Consult Appendix A or B for possible causes of the reverse flow and take corrective action.

(e) Move a lighted smoke candle throughout the fume hood work area, directing smoke across the work surface and against the side walls and baffle. Smoke should be contained within the fume hood and be rapidly exhausted. Fume hoods with horizontal sliding sash(es) will show reverse flow and turbulence behind sash panel, but no outflow of smoke shall be evident.

7.2.6 Evalution of Low Air Flow Monitor. On fume hoods with low flow warning devices, verify that monitor functions properly and indicates unsafe conditions.

APPENDICES

(These Appendices are not part of the SEFA Recommended Practices for Laboratory Fume Hoods, but are included for information.)

Appendix A: Trouble Shooting

When fume hood test procedures detect improper function, the cause is normally due to insufficient quantity of air flowing through the hood, or due to room cross drafts blowing into or across the face of the fume hood, or a combination of both. The following suggestions are offered to help pinpoint and correct the problem.

A1 ROOM CROSS DRAFTS

A1.1 Air moving through an open door located adjacent to the fume hood can cause cross drafts.

A1.2 An open window or a room air supply grill located to one side or across from the fume hood can cause disturbing cross drafts.

A1.3 High velocity air from ceiling-mounted diffusers or room air supply can cause a flow of air down and into the top half of the fume hood face that can reverse air flow out of the bottom half of the face.

A2 INSUFFICIENT AIR FLOW

Insufficient air flow through the fume hood can be caused by one or more of the following conditions. Each condition should be checked, and eliminated if possible, to determine which one or combination of conditions may exist.

A2.1 One possible explanation for low face velocity reading is inaccurate face velocity readings.

A2.1.1 Check air flow velocity meter type. Is the recommended model being used? When was it calibrated last? Is the battery good? Was the instrument zeroed before taking readings?

A2.1.2 If the recommended model was not used, check to make sure the instrument is recommended for low air velocities in the 50 to 150 feet per minute (15.24 m/min to 45.7 m/min) (.25 m/s to .76 m/s) range.

A2.1.3 If possible, verify readings with another air velocity meter or by checking air volume using a pitot tube traverse of exhaust duct.

A2.2 Low air flow through the fume hood can be caused by a large negative room static pressure as a result of inadequate make-up air being brought into the room. With the fume hood and other exhaust blowers in operation, check room static pressure by:

A2.2.1 Verification using inclined manometer.

A2.2.2 Checking inrush of air into the room through a door or an open window.

A2.2.3 Checking ventilation system balance and verifying the quantity of make-up air.

A2.3 In some fume hood designs, improper baffle adjustment can throttle the air flow through the fume hood.

A2.3.1 Are fume hood adjustment strips in an open position?

A2.3.2 Are baffle openings blocked with large or bulky apparatus?

A2.4 Improper sizing or operation of exhaust blower or both may be the cause.

A2.4.1 Is blower rotation correct?

A2.4.2 Are make and model correct as specified?

A2.4.3 Is supply voltage correct? Is motor correctly wired?

A2.4.4 Are motor horsepower and speed correct?

A2.4.5 Does blower have an outlet screen or louvers? Are they clean and operating properly?

A2.4.6 Make sure that plates used to close blower inlet and outlet during shipment were removed prior to connecting ductwork.

A2.4.7 Does blower also serve other systems? If so, make sure balance is correct.

A2.4.8 Was blower properly sized for the system? Verify by static pressure loss and air flow measurements.

A2.4.9 On belt-driven fans, check belt tension.

A2.5 Ductwork can restrict air flow, if not properly designed and installed, and should be checked. Are dampers located in exhaust duct? If present, are they opened?

Appendix B: Laboratory Building Considerations

The following recommendations are provided to assure optimum performance and safe operation of laboratory fume hoods. Various technical aspects of each application require consideration in order to size a blower properly to a fume hood application. Such factors as fume hood static pressure loss and duct loss must be compensated for in the selection of a blower; therefore, consultation with a fume hood specialist is recommended. The following basics apply to any and all fume hood applications.

B1 SAFETY CONSIDERATIONS

B1.1 Laboratory fume hoods are potential locations for fires and explosions due to the types of experiments conducted in these units. As such, fume hoods should be located within the laboratory so that in the event of a fire or explosion within the fume hood, exit from the laboratory would not be impeded.

B1.2 Laboratory fume hoods should be located away from high traffic lanes within the laboratory because personnel walking past the sash opening may disrupt the flow of air into the unit and cause turbulence, drawing hazardous fumes into the laboratory.

B1.3 Sufficient aisle space should be provided in front of the fume hood to avoid disruption of the work or interference with the operating technician by passing personnel.

B1.4 Safety devices such as drench showers, eye wash stations, fire extinguishers, first aid kits and fire blankets should be located convenient to the fume hood operating personnel and plainly labeled as to their use and function.

B2 PLANNING CONSIDERATIONS

B2.1 Laboratory fume hood exhaust systems should be balanced with room exhaust systems and may be used in conjunction with room exhaust to provide the necessary room ventilation. Constant operation of a fume hood will also provide fume control during non-working hours.

B2.2 Laboratory fume hoods should be so located within the laboratory to avoid cross currents at the fume hood face due to heating, cooling or ventilating inlets.

B2.3 Sufficient make-up air must be available within the laboratory to permit fume hoods to operate at their specified face velocities.

B3 DUCT SYSTEM DESIGN

B3.1 Optimum fume hood performance and laboratory flexibility is achieved when a separate duct system and blower is utilized for each laboratory fume hood.

B3.2 In order to minimize static pressure loss and blower power consumption within a duct system, fume hood ducts should be of a sufficient size to permit the rated flow of air through the duct at a velocity no greater than 2000 feet per minute (609.6 m/min) (10.16 m/s).

Note: The static pressure loss of the duct system is proportional to the square of the velocity of the air through the duct. The higher the air velocity, the greater the static pressure loss that occurs. Duct velocities in excess of 2000 feet per minute (609.6 m/min) (10.16 m/s) should also be avoided for acoustical reasons and to conserve energy. Duct velocities in excess of 2000 feet per minute (609.6 m/min) (10.16 m/s) may be used if resulting increases in sound levels, static pressure and blower power requirements are acceptable.

B3.3 Due to the nature of the material handled in a fume hood exhaust system, materials of construction should be corrosion resistant and non-combustible. Combustible ducts, exhibiting a flame spread index of 25 or less when tested in accordance with ASTM E-84 may be used, if installed in accordance with approved standards and regulations. For minimal friction losses within the duct, smooth interior surfaces are recommended.

B3.4 Elbows, bends and offsets within a duct system should be kept to a minimum and should be long sweep in design configuration in order to minimize static pressure losses.

B3.5 Ducts with round cross sections are recommended because they exhibit less static pressure loss than square or rectangular duct configurations of equal cross sectional area.

B3.6 Fume hood exhaust systems should not interconnect with other ventilation duct systems.

B3.7 Volume, back-flow or fire control-type dampers may not be utilized in fume hood exhaust systems.

B4 BLOWER LOCATION AND SIZE

B4.1 Where laboratory building design permits, the exhaust blower should be located on the roof of the building to provide a negative pressure in that portion of the duct system located within the building.

B4.2 The exhaust blower should be sized to exhaust the volume of air necessary to attain the selected fume hood face velocity at the total system static pressure loss.

B4.3 Blowers should be sized to achieve the lowest practical angular speed of the impeller thereby avoiding high impeller tip speeds and minimizing noise associated with this revolving member.

B5 MAKE-UP AIR

B5.1 Make-up air is a ventilation term indicating the supply of outdoor air to a building replacing air removed by exhaust ventilation systems. In general, laboratories require six to sixteen total volume changes per hour. Special applications may require up to 20 air changes per hour.

B5.2 A sufficient quantity of make-up air must be available to allow fume hoods to develop required face velocities.

B5.3 Consideration must be given to the make-up required for air changes in each specific laboratory involved. This data must be coordinated with fume hoods and ventilation equipment.

B5.4 In order to provide a balanced and functioning system, all factors such as fume hood exhaust volume, air change data, make-up air systems and auxiliary air performance, if applicable, must be considered.

B5.5 Due to the possibility of toxic and/or hazardous material being handled within laboratories, air exhausted from these laboratories should not be recirculated.

B5.6 Laboratories using chemicals should operate at a slight negative pressure as compared to the remainder of the building.

Appendix C: Laboratory Fume Hood Inspection and Maintenance

C1 INSPECTION

C1.1 Safety considerations require that a schedule of inspection and documentation be set up for every laboratory fume hood at least annually.

C1.2 An inspection record should be maintained. This record may be in the form of a label attached to the fume hood, or a log maintained by the laboratory director or health safety director.

C1.3 Inspection procedures should include instrument verification of fume hood face velocity and a determination of usage by observation and interview.

C1.4 Inspection procedures should consist of a physical examination of liner condition and cleanliness, baffle and sash operation and condition, counter balance cables, light operation and condition, and service fixture function.

C1.5 Inspection results should be recorded and reported to the proper authority for any required action.

Note: Special purpose fume hoods such as those used with radioactive materials or perchloric acid require additional inspection procedures to cover special equipment and requirements. (See Appendix D, section D3.4.)

C1.6 Options, such as low air flow detectors, when installed, should be inspected at least annually. Where extremely hazardous or corrosive conditions exist or when filters are present in the system, the inspection frequency should be increased appropriately. Velocity and pressure-sensing detectors should be tested at each inspection. Low-flow or no-flow alarms of the visible or audible type should be tested for correct operation at least at each inspection. Signal transmission for alarms designed to activate signals at more than one location should be verified at each location during each inspection. When air flow detectors are not provided, or measured air flow tests are not made quarterly, fan belts should be inspected quarterly. Frayed or broken belts should be replaced promptly. Where double pulleys and belts are employed, the inspection frequency may be semiannually.

C2 MAINTENANCE

C2.1 Fume hood maintenance procedures consist primarily of clean-up, adjustment, lubrication and replacement of worn, damaged or nonfunctioning parts. Use good housekeeping in laboratory fume hoods at all times. Periodically clean sash(es), exterior and interior surfaces, including fluorescent light panel. Replace fluorescent lamps periodically to maintain adequate illumination.

C2.2 Clean-up should be accomplished by, or under the supervision of, a knowledgeable laboratory safety officer and should include removal of the baffle for clean-up of all interior surfaces.

C2.3 Lubrication of sash guides, cables, pulley wheels and other working parts should be accomplished as required or in accordance with manufacturer's recommendations.

C2.4 Replace broken, worn or nonfunctioning parts as required.

C2.5 Flush all spills immediately using neutralizing compounds as required and clean thoroughly.

Note: Special parts, options and accessories should be maintained as required.

Appendix D: Use and Operation Recommendations

D1 USE OF LABORATORY FUME HOODS

D1.1 Limit laboratory fume hood use to those activities for which the unit is designed. Alternative devices, such as safety cabinets or glove boxes, should be used when appropriate.

D1.2 Only specially-designed laboratory fume hoods should be used for perchloric acid work. This fume hood type should be labeled and its use should be limited to perchloric acid procedures.

D1.3 Use of laboratory fume hoods as storage enclosures for corrosive, toxic or flammable materials may jeopardize fume hood performance and create unnecessary hazards. Limit materials within the hood to those required for immediate use.

D2 GENERAL OPERATIONS

D2.1 Turn on interior light for proper illumination of work area.

D2.2 Verify that exhaust system is operating properly and that air is entering and flowing through the fume hood before starting fume producing activities.

D2.3 Safe and proper fume hood operation requires an understanding of the function of fume hood baffles and various baffle settings. Different fume hood designs require variations in baffle settings. Operators must adhere to fume hood manufacturer's instructions relative to baffle position for safe and efficient function.

D2.4 Set-ups and apparatus should be as far back from the fume hood face as possible for safety and optimum performance. A set back of six inches (15.2 cm) (152 mm) is necessary for proper fume hood operation. Avoid blocking off baffle openings.

D2.5 Large bulky objects should not be placed directly on fume hood working surface. Block up two to three inches (5.08 cm) (50.8 mm) to (7.6 cm) (76 mm) to permit a flow of air under the object and into lower rear baffle exhaust opening.

D2.6 Avoid rapid movement and excessive personnel passage in front of the fume hood. Air disturbances so created may draw fumes out of the hood.

D2.7 The laboratory fume hood sash is designed to be used as a safety shield. Move vertical type sash to the lowest position that provides proper access and carry out manipulations with sash protecting head and upper body. When feasible, use horizontal sliding sash as a face and body shield.

D2.8 As a safety precaution, avoid placing head inside of laboratory fume hood.

D2.9 On fume hoods without a bypass, avoid closing sash(es) completely when the blower is on and the fume hood is in use.

D2.10 Laboratory fume hood sash(es) should be kept closed when the exhaust system is turned off and the hood is not in use.

D2.11 Never permit temperature of inside of sash surface to reach or exceed 160 degrees F (71.1 degrees C) unless the sash material is the heat-resistant type.

D3 OPERATION OF PERCHLORIC ACID FUME HOODS

Caution: Only personnel fully cognizant of the properties of perchloric acid and the hazards associated with it should perform perchloric acid procedures.

D3.1 Use only specifically designed laboratory fume hoods for perchloric acid. This type of fume hood should be so labeled and not used as a general purpose laboratory fume hood. Miscellaneous work should not be performed in perchloric acid fume hoods because of extreme hazards.

D3.2 Follow all operations of general purpose laboratory fume hoods (section D2.1 through D2.11).

D3.3 Duct and hood washdown systems are not designed to be used as exhaust scrubbing devices. Do not operate washdown system while working in the hood.

D3.4 Inspection of all hood and duct interior surfaces should take place periodically to verify that washdown system is functioning properly and that no build-up of perchloric salts is occurring. Remove baffle(s) for access to all surfaces and flush away any remaining deposits.

D3.5 Utilize lowest quantities of perchloric acid to fit procedural requirements.

D3.6 Spark-producing apparatus should not be used inside a perchloric acid fume hood.

D3.7 All apparatus used within the hood interior should have inorganic coatings and lubricants.

D3.8 Winter temperatures require that washdown system parts exterior to the building have a drain valve to prevent freezing. System should be designed to drain completely after use.

D.4 Warning label on Fume Hood, Size 6" x 4"

Appendix E: General Information

E1 ENERGY CONSIDERATIONS

E1.1 Increasing energy costs and new emphasis on the conservation of energy have caused fume hood designers, specifiers and users to review fume hood air consumption and to make efforts to reduce air volume requirements.

E1.2 Since the primary purpose of the laboratory fume hood is safety, any revisions must not compromise this principle. Safety is the only consideration, regardless of energy consumption. Some acceptable conservation procedures are:

E1.2.1 Careful selection of face velocities. 100 feet per minute (30.48 m/min) (.51 m/s) will meet most requirements, 75 to 80 feet per minute (22.9 m/min to 24.4 m/min) (.38 m/s to .41 m/s) is acceptable for some applications. Excessive velocities may actually hamper fume hood function and ceate hazardous conditions.

E1.2.2 Reduced Operating Hours. Unused hoods are turned off. Hoods must run when fumes are present.

E1.2.3 Restricted Access. Use of horizontal sashes or stops on vertical sashes reduce face area and air volume requirements. Fail-safe designs and laboratory discipline are necessary adjuncts.

E1.2.4 Auxiliary Air Fume Hoods. Conservation of up to 75% of expensive conditioned air is possible with this design. Air supplied to the hood should be tempered for operator comfort and acceptable performance.

E1.2.5 Manual or Automatic Two-Speed Fans. Controls are tied to sash position for fail-safe operation.

E2 LABORATORY FUME HOOD SOUND LEVELS

E2.1 Current standards requiring higher face velocities and resulting greater exhaust volumes and static pressure levels have created a potential for objectionable noise levels created by the fume hood exhaust system.

E2.2 Since most objectionable sound levels originate with the exhaust fan, care in the selection of the type, size and location will result in relatively quiet operation.

E2.3 To minimize noise levels, consider the following points:

E2.3.1 Select an exhaust fan that has a low sound level at the required R.P.M. Axial fans and paddle wheel designs tend to be noisy and should be avoided.

E2.3.2 Sound levels increase with high impeller tip speeds, so selection of a large diameter impeller turning relatively slowly will provide quieter operation.

E2.3.3 When possible, select a forward curved impeller wheel for low R.P.M. and quiet operation.

E2.3.4 Locate the blower at the discharge end of the duct. This is not only a good practice, but also places the unit as far as possible from the fume hood operator.

E2.4 Other factors should also be considered. Every effort should be made to:

(a) Isolate the blower from the building structure and from the duct system to reduce transmitted vibrations. Avoid locating the blower on the hood.

(b) Design the duct system to provide low velocities and minimum static pressure.

E2.5 Velocities around 1400 feet per minute (426.7 m/min) (7.1 m/s) are relatively silent while velocities in the 1600 feet per minute (487.68 m/min) (8.12 m/s) range are noticeable but not ordinarily objectionable. Velocities in excess of 2000 feet per minute (609.6 m/min) (10.16 m/s) should be used with caution, since they cause higher sound levels which are sometimes objectionable. Low velocities reduce static pressure and permit the use of quiet blowers.

E2.6 Auxiliary air systems used with fume hoods handle uncontaminated air and can be silenced by any acceptable means selected by the specifier.

E3 INTERCONNECTED SYSTEMS - WHEN SEVERAL FUME HOODS ARE CONNECTED TO A SINGLE EXHAUST BLOWER

While there are many aspects to proper exhaust system design, it is recommended that the principle of one fume hood, one exhaust duct and one blower be followed for maximum safety, flexibility and control over laboratory exhaust. Perchloric acid fume hoods must always have a single, separate exhaust system because of washdown requirements. Other special purpose fume hoods may also require a separate sytem. Engineers and designers are cautioned that manifolding several laboratory fume hoods to a single duct and blower may create potential hazards and problems as detailed below.

E3.1 Balancing Difficulty. It is extremely difficult, if not impossible, to design a system that will operate properly without dampers, and balancing dampers may malfunction because of corrosion or mechanical failure. Further, adjustment of air flow at one interconnected hood will change the air flow (face velocity and exhaust volume) for all other hoods connected to the same system. Adjustment of the second hood will change the air flow of all of the interconnected hoods, including the first one.

E3.2 Pathway For Fire and Explosions. Interconnection of multiple hoods provides a pathway for fire from room to room and floor to floor. (NFPA Standard No. 45 recommends against fire dampers in fume hood exhaust ducts.)

E3.3 Uncontrolled Chemical Reactions. Fumes and gases being exhausted from one laboratory hood can meet and react with products being exhausted from a second laboratory hood. Results are unpredictable and potentially hazardous.

E3.4 Reduced Flexibility. When fume hoods are interconnected, it is extremely difficult, if not impossible, to make face velocity adjustments for reclassification of the hood or to meet the requirements of new regulations and standards. This lack of flexibility may preclude the use of certain chemicals or prevent the use of the hood for new applications.

E3.5 Energy Considerations. When multiple hoods are served by a single blower, extended operation of a single hood requires that all interconnected units operate. For proper function, expensive conditioned air must be supplied to all hoods in the system, resulting in an increase in energy consumption beyond actual requirements.

E3.6 Radioisotope Fume Hoods. Fume hoods with filters in the exhaust duct should always have independent duct and blower systems.

E4 INSTALLATION OF FUME HOODS

E4.1 Place the fume hood work surface, if separate, on the supporting unit. Make certain the supporting unit is plumb, level, true and straight either by means of shims or be leveling bolts. Secure the top to supporting unit by means of screws, cement, or clamps.

E4.2 Verify that all parts of the fume hood superstructure have been delivered to the jobsite free of uncorrectable damages, burrs, etc. Make certain that no parts of the fume hood have been damaged in transit, unloading or handling.

E4.3 Place fume hood superstructure on the work surface. Make superstructure plumb and level. Secure to counter top by screws, "L" brackets, or cement. If fume hood is fitted with an auxiliary air chamber, verify that hood is securely anchored to building to prevent toppling forward.

E4.4 Verify that all adjustable baffles operate freely, without binding or constriction.

E4.5 Check to insure that the sash(es) operates freely, without binding or constriction, and in a nearly silent manner. Sash(es) shall be operable from either end with one hand. Sash counterbalances shall operate without interference or construction, and also in a nearly silent manner.

E4.6 A general inspection of the fume hood should be made to make certain all screws are tight and all parts are in their proper position.

E5 FUME HOOD EXHAUST SCRUBBERS

E5.1 Materials exhausted from laboratory fume hoods are usually disposed of by dilution into the atmosphere. Exhaust from radioisotope fume hoods, however, has been filtered since larger volume work began with radioactive materials.

E5.2 Most scrubbing devices use water as the scrubbing liquid and should incorporate a water purification procedure.

E5.3 Properly designed scrubbers will remove particles, aerosols and gases, performing most effectively with the latter if they have a high solubility in water.

E5.4 Different types of scrubbing devices which might be used with fume hood exhaust are:

E5.4.1 chamber scrubber. A simple scrubber system where the dust-laden gas enters and leaves a chamber. The chamber contains one or more spray nozzles producing water jets across the chamber, providing a liquid screen to cause impact with the dispersoids, dropping them from the gaseous waste.

E5.4.2 cyclonic scrubber. A wet collector that combines scrubbing and cyclonic action. Water droplets condition the aerosol particles by impaction, humidification and condensation. The cyclonic or centrifugal motion of the gaseous waste causes the conditioned particles to separate from the gas phase by the inertial mechanism.

E5.4.3 inertial scrubber. A wet collector in which the surface area of the scrubbing liquid is expanded and displaced by the energy of the moving gas stream. This category includes impingement baffle scrubbers, venturi scrubbers and inertial orifice scrubbers. Air pressure drop in these scrubbers is severe and consequently requires more energy.

E5.4.4 mechanical scrubber. A wet scrubber that employs mechanically driven elements to break up the scrubbing liquid into small droplets to secure intimate contact between the gaseous waste and the scrubbing liquid. In this group there are mechanical spray generators and disintegrator scrubbers.

E5.4.5 packed scrubber. A wet scrubber employing a conventional tower packed with rings, saddle, tile or coke. Collection is primarily due to impingement on the packing. The scrubbing liquid then washes the packing free of collected solids.

E5.4.6 froth collector. A wet scrubber that creates a froth by varying methods causing dispersoids to impinge on spray droplets.

E6 FUME HOOD WEATHER CAP DESIGNS

Please refer to the diagrams on page 19 (Figures 1 to 4):

E6.1 Rain protection characteristics of stack head designs. Figures 2, 3 and 4 are superior to a deflecting cap located 0.75D from the top of the stack.

E6.2 The length of upper stack is related to rain protection. Excessive additional length, however, may cause "blowout" of effluent at the gap between upper and lower sections.

E6.3 Height of the lower stack above roof should be designed based on local topographic conditions.

FUME HOOD WEATHER CAP DESIGNS

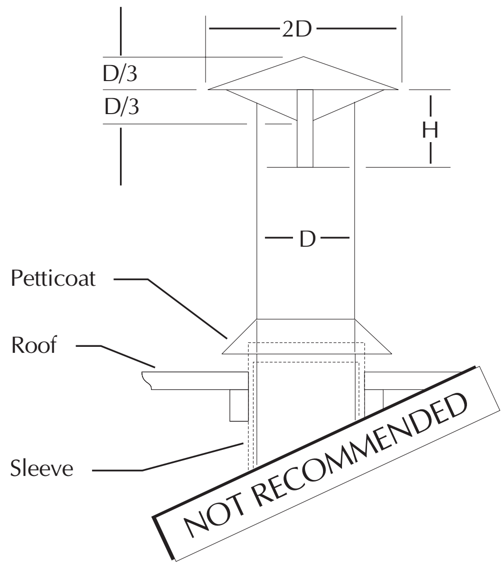
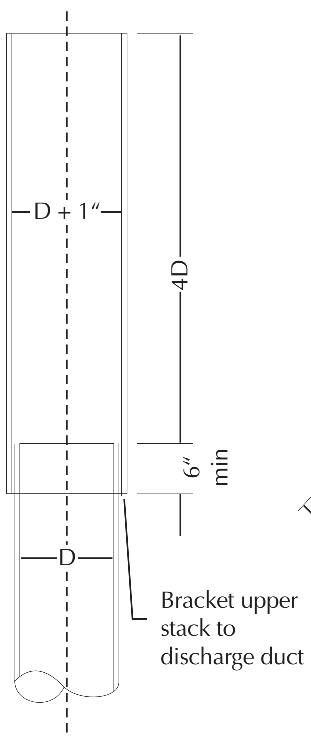
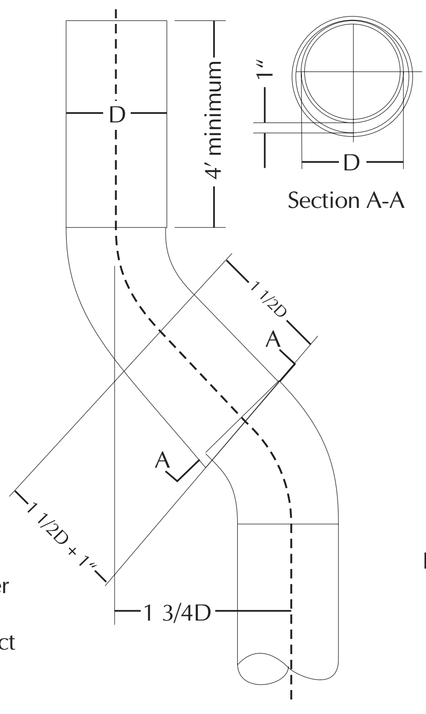
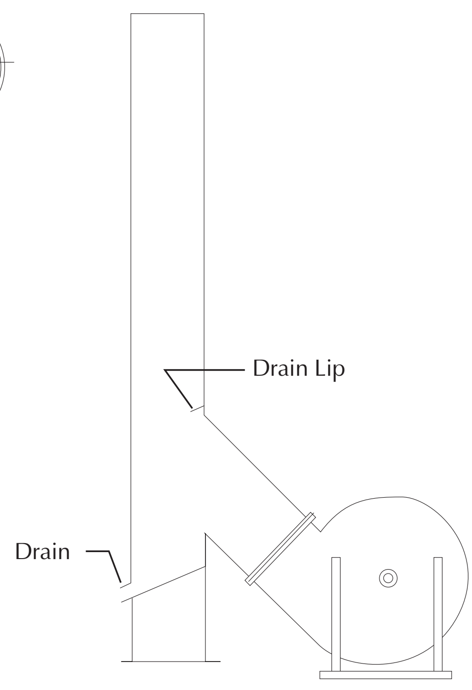


FIGURE 1







VERTICAL DISCHARGE

No Loss

FIGURE 2

OFFSET ELBOWS

FIGURE 3

OFFSET STACK

FIGURE 4

Calculate losses due to elbows

NOTE: Diagram reprinted with the permission of the American Conference of Governmental Industrial Hygienists.

FUME HOOD FACE VELOCITY SAMPLING GRIDS

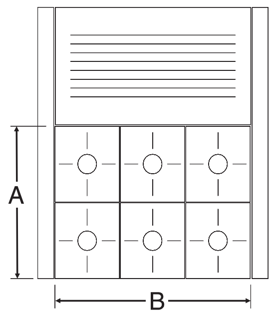


Figure 1. Fume Hood Face Velocity Sampling Grid for Bench Mounted Hood

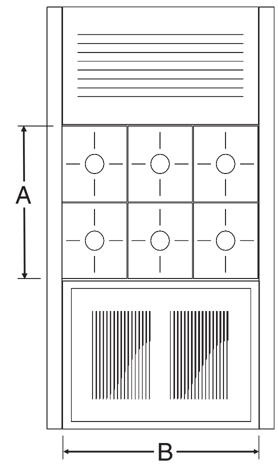


Figure 2. Fume Hood Face Velocity Sampling Grid for Walk-In Hood

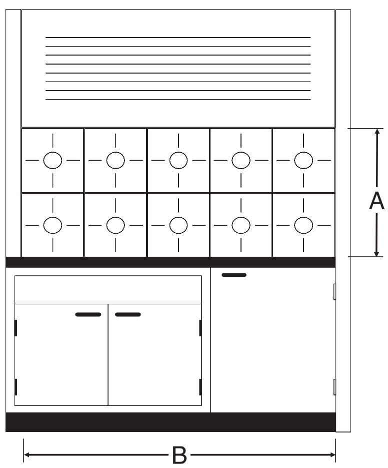


Figure 3. Fume Hood Face Velocity Sampling Grid for a Combination Hood

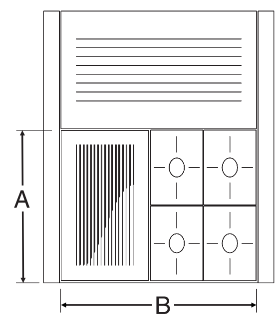


Figure 4. Fume Hood Face Velocity Sampling Grid for a Bench Mounted Fume Hood with Horizontal Sliding Sash(es)

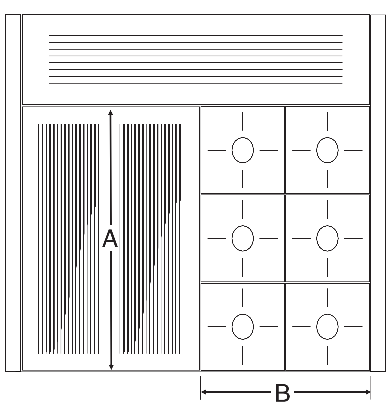
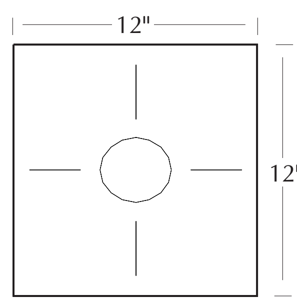


Figure 5. Fume Hood Face Velocity Sampling Grid for Walk-In Hood with Horizontal Sliding Sash(es)

GRID SIZE NOTE:



Maximum Grid: 12" x 12"
(30cm x 30cm)